CLAIMS

What is claimed is:

1. A method for in-season nutrient application to a crop including the steps of:

(a) determining a maximum potential yield;

(b) determining a nutrient response index for a field;

(c) determining a reference coefficient of variation for the response index;

(d) measuring a normalized difference vegetation index for a plot within said field;

(e) determining a coefficient of variation within said plot;

(f) determining a predicted yield for said plot;

(g) determining an attainable yield with added nutrient as a function of said predicted yield, said response index, and said coefficient of variation;

(h) determining the nutrient removal at said predicted crop yield;

(i) determining the nutrient removal at said attainable yield;

(j) determining the amount of additional nutrient which must be supplied to achieve said attainable crop yield; and

(k) applying said amount of nutrient to said plot.

2. The method for in-season nutrient application to a crop of claim **1** wherein step (b) includes the substeps of:

(b) determining a nutrient response index for a field by performing the steps of:

(i) providing a first area treated with the nutrient such that said first area is a non-limiting fertilized area;

(ii) providing a second area treated with a predetermined amount of the nutrient;

(iii) determining a normalized difference vegetation index for said first area;

(iv) determining a normalized difference vegetation index for said second area; and

(v) dividing said normalized difference vegetation index for said first area by said normalized difference vegetation index for said second area.

3. The method for in-season nutrient application to a crop of claim **1** wherein step (d) includes the substeps of:

(d) determining the normalized difference vegetation index for a plot within said field by performing the steps of:

(i) scanning said plot with a with a reflectance sensor, said reflectance sensor sensing reflectance at red light and at near infrared light;

(ii) determining the reflectance of the vegetation in said plot to red light;

(iii) determining the reflectance of the vegetation in said plot to near infrared light; and

(iv) dividing the difference of the reflectance determined in step (d)(ii) minus the reflectance determined in step (d)(iii) by the sum of the reflectance determined in step (d)(ii) and he reflectance determined in step (d)(iii).

4. The method for in-season nutrient application to a crop of claim **3** wherein step (e) includes the substeps of:

(e) determining a coefficient of variation within said plot by performing the steps of:

(i) performing steps (d)(i) through (d)(iv) successively over said plot;

(ii) calculating the standard deviation of the normalized difference vegetation index of said plot;

(iii) calculating the mean of the normalized difference vegetation index of said plot; and

(iv) calculating the coefficient of variation of the normalized difference vegetation index for said plot.

5. The method for in-season nutrient application to a crop of claim **1** wherein step (f) includes the substeps of:

(f) determining a predicted yield for said plot by performing the steps of;

(i) determining the number of growing days since the planting of the crop;

(ii) calculating an in-season estimated yield index for said plot by dividing said normalized difference vegetation index measured in step (d) by said number of growing days determined in step (f)(i); and

(iii) calculating the predicted crop yield for said plot as a function of the in-season estimated yield index for said area.

6. The method for in-season nutrient application to a crop of claim **1** wherein step (g) includes the substeps of:

(g) determining an attainable yield by performing the steps of:

(i) adjusting the response index of step (b) as a function of the coefficient of variation of step (e); and

(ii) multiplying the predicted yield of step (f) times the adjusted response index of step (g)(i);

7. The method for in-season nutrient application to a crop of claim **1** wherein said nutrient is nitrogen.

8. The method of claim **1** wherein the coefficient of variation determined in step (e) is the coefficient of variation of the normalized difference vegetation index measured in step (d).

9. The method of claim **1** wherein the coefficient of variation determined in step (e) is the coefficient of variation of plant height of plants within said plot.

10. A method for determining an application rate for nitrogen fertilizer including the steps of:

(a) determining a nitrogen response index for a field by measuring the NDVI of a nitrogen rich test strip and the NDVI of a test strip with nitrogen applied according to conventional practice;

(b) measuring the NDVI of a plot within said field;

(c) determining a coefficient of variation within said plot;

(d) determining a predicted yield for said plot;

(e) determining an attainable yield as a function of said predicted yield, said response index, and said coefficient of variation;

(f) determining the nitrogen removal at said predicted crop yield;

(g) determining the nitrogen removal at said attainable yield;

(h) determining the amount of additional nitrogen fertilizer which must be supplied to achieve said attainable yield; and

(i) applying said amount of nitrogen fertilizer to said plot.

11. A method for determining an application rate for nitrogen fertilizer including the steps of:

(a) determining a nitrogen response index for a field by measuring the NDVI of a nitrogen rich test strip and the NDVI of a test strip with nitrogen applied according to conventional practice;

(b) measuring the NDVI of a plot within said field;

(c) determining the height of a plant within said plot;

(d) determining a predicted yield for said plot;

(e) determining an attainable yield as a function of said predicted yield, said response index, and said height of said plant;

(f) determining the nitrogen removal at said predicted crop yield;

(g) determining the nitrogen removal at said attainable yield;

(h) determining the amount of additional nitrogen fertilizer which must be supplied to achieve said attainable crop yield; and

(i) applying said amount of nitrogen fertilizer to said plot.

12. A method of communicating the proper amount of a nutrient to apply to a plant including the steps of:

(a) determining an expected yield potential of a plant in a crop of plants under current conditions;

(b) determining a maximum potential yield for said crop of plants with added nutrient;

(c) determining a proper amount of the nutrient to apply to said plant by calculating the difference between said maximum potential yield and said expected yield potential; and

(d) communicating said proper amount of the nutrient to apply to said plant.

13. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **12**, wherein said expected yield potential is determined by remotely sensing at least one attribute of said plant that is indicative of the plant's nitrogen status.

14. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **13**, wherein said at least one attribute comprises reflectance information of said plant.

15. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **14**, wherein said reflectance information comprises spectral data from red or near infrared spectral bands.

16. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **15**, wherein said expected yield potential is determined by:

(i) determining the reflectance of said plant to red light;

(ii) determining the reflectance of said plant to near infrared light; and

(iii) dividing the difference of the reflectance determined in step (ii) minus the reflectance determined in step (i) by the sum of the reflectance determined in step (i) and the reflectance determined in step (ii).

17. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **12**, wherein said maximum potential yield is determined by:

(i) growing a portion of said crop in non-limiting conditions with respect to said nutrient;

(ii) determining the yield of crop by remotely sensing at least one attribute of plants within said portion of said crop, said at least one attribute being indicative of biomass and nitrogen content.

18. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **17**, wherein said at least on attribute comprises reflectance information.

19. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **18**, wherein said reflectance information comprises data from the red or near infrared spectral bands.

20. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **18**, wherein said reflectance information comprises a vegetation index.

21. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **20**, wherein said vegetation index is determined by:

(i) determining the reflectance of said plants within said portion to red light;

(ii) determining the reflectance of said plants within said portion to infrared light; and

(iii) dividing the difference of the reflectance determined in step (ii) minus the reflectance determined in step (i) by the sum of the reflectance determined in step (i) and the reflectance determined in step (ii).

22. The method of communicating the proper amount of a nutrient to apply to a plant according to claim **12**, wherein said proper amount of the nutrient to apply to said plant comprises:

(i) determining the amount of said nutrient in said expected yield;

(ii) determining the amount of said nutrient in said maximum attainable yield; and

(iii) determining the amount of additional said nutrient which must be applied to said plant to achieve said maximum potential yield.

24. A non-volatile memory comprising instructions that when executed perform the method of:

(a) determining an expected yield potential of a plant in said crop of plants under current growing conditions;

(b) determining a maximum attainable yield for a crop of plants with added nutrient;

(c) determining a proper amount of a nutrient to apply to said plant by calculating the difference between said maximum attainable yield and said expected yield potential; and

(d) communicating said proper amount of nutrients to apply to said plant.

25. A method for automatically determining the response index for a field including the steps of:

(a) providing a first area within a field having a crop planted therein, said first area being fertilized with a nutrient such that said nutrient will not be limiting as to the production of said crop;

(b) providing a second area within said field, said second area being adjacent said first area and fertilized according to the common practice within said field;

(c) after emergence of said crop within said first and second areas, scanning said first area with a scanner for sensing a characteristic of said crop indicative of a nutrient status;

(d) contemporaneous with the scanning in step (c), scanning said second area with said scanner;

(e) within said scanner pairing a first site from said first area with an adjacent second site from said second area; and

(f) within said scanner determining a response index for said first and second sites as a function of the nutrient status of said first site and the nutrient status of said second site.

26. The method for automatically determining the response index for a field according to claim **25**, wherein multiple measurements are performed within

said first and second sites during the scanning operations of steps (c) and (d), including the further steps of:

(g) determining a coefficient of variation for said first site; and

(h) determining a coefficient of variation for said second site.

27. The method for automatically determining the response index for a field of claim **25** wherein said scanner comprises a manual sensor having position sensing capability.

28. The method for automatically determining the response index for a field of claim **25** wherein said scanner comprises a tractor having a first boom projecting from a left side and a second boom projecting from a right side, said first boom including a first sensor for sensing said nutrient status of said crop and said second boom including a second sensor for sensing said nutrient status of said crop and wherein steps (c) and (d) are performed simultaneously while driving said tractor between said first and second areas, one of said first and second booms projecting over said first are and the other of said first and second booms projecting over said second area.